POLISHING PAD AND FABRICATING METHOD THEREOF

DESCRIPTION

CROSS-REFERENCE TO RELATED APPLICATION

[Para 1] This application claims the priority benefit of Taiwan applications serial no. 92126795, filed September 29, 2003 and serial no. 93102897, filed February 09, 2004.

BACKGROUND OF THE INVENTION

[Para 2] Field of the Invention

[Para 3] The present invention relates to a polishing pad and fabricating method thereof, and more particularly to a polishing pad and fabricating method of the same suitable to prevent particles from being generated during a polishing process.

[Para 4] Description of the Related Art

[Para 5] Nowadays, chemical mechanical polishing (CMP) processes are commonly used to achieve global planarization. In a conventional CMP process, polishing slurry containing abrasive particles is applied on the surface of a wafer and set in relative motion with respect to a polishing pad with appropriate elasticity and hardness for the purpose of planarization of the wafer.

[Para 6] FIG. 1 shows a top view and a side view of a wafer carrier holding a wafer on a polishing pad in a conventional polishing process. As shown in FIG. 1, a wafer 100 is held by a wafer carrier 102, for example, in a way that a retaining ring 104 is used to attach the wafer 100 on the bottom surface of the wafer carrier 102. The wafer carrier 102 holds the wafer 100 to spin on the

polishing pad 110, and the polishing pad 110 itself also rotates driven by a polishing table, while a polishing slurry is provided between the surface of the wafer 100 and the polishing pad 110 for the polishing process. Abrasive particles in the slurry contact with and rub against the surface of the wafer 100, which causes abrasion on the surface of the wafer 100 and thus make the surface becoming planar. The relative motion between the polishing pad 110 and the surface of the wafer 100 includes not only rotational motion of the wafer 100 and the polishing pad 110 but also horizontal swing motion of the wafer 100.

[Para 7] Referring further to FIG. 1, when the wafer carrier 102 brings the wafer 100 slightly in a horizontal swing motion within the polishing region 112 of the polishing pad 110, the motion will induce a compressive stress on the polishing pad 110 towards the center of the polishing pad 110 so as to compress the central region 114 to become protruded. When the wafer 100 continues to be polished on the protruded polishing pad 110, the retaining ring 104 on the wafer carrier 102 may rub against the protruded surface of the central region 114 of the polishing pad 110 and thus generate particles. Since a trench 106 is ordinarily designed in the retaining ring 104 on the wafer carrier, the particles generated due to the rubbing may pass through the trench 106 in the retaining ring 104, reach the wafer 100, and further contaminate the wafer 100.

[Para 8] In addition, since the polishing surface of the polishing pad 110 is perpendicular with the sidewall 116 of the polishing pad 110, when the wafer carrier 102 brings the wafer 100 slightly in a horizontal swing motion within the polishing region 112, the retaining ring 104 on the wafer-holding device 102 may rub against the sidewall 116 of the polishing pad 110 to generate small particles, and the particles may pass through the trench 106 in the retaining ring 104, reach the wafer 100, and further contaminate the wafer 100.

[Para 9] During a conventional polishing process, as described above, the surface of the central region or the edge portions of the polishing pad may rub

against the retaining ring of the wafer carrier, which will generates small particles to contaminate the wafer.

SUMMARY OF THE INVENTION

[Para 10] Accordingly, the present invention is directed to a polishing pad and a fabricating method thereof, so as to prevent particles from being generated in the central region of the polishing surface under compressing stress during a polishing process.

[Para 11] The present invention is directed to a polishing pad and a fabricating method thereof, so as to prevent particles from being generated on the sidewall of the polishing pad during a polishing process.

[Para 12] According to an embodiment of the present invention, a polishing pad is provided as having a polishing surface, a back surface, and a sidewall connected with the polishing surface and the back surface, and being divided into a polishing region and a region neighboring to the polishing region. Wherein, at least one stress buffer pattern is designed within the region of the polishing pad to buffer compressing stress generated in the region during the polishing process and to prevent the surface of the region from being protruded.

[Para 13] According to another embodiment of the present invention, a fabricating method of a polishing pad having a polishing surface, a back surface, and a sidewall connected with the polishing surface and the back surface is provided. The method includes formation of a polishing region and at least one stress buffer pattern within a region of the polishing pad neighboring to the polishing region so as to buffer compressing stress generated in the region during the polishing process and to prevent the surface of the region from being protruded.

[Para 14] The present invention further provides another polishing pad, which has a polishing surface, a back surface, and a sidewall connected with polishing surface and the back surface. Wherein, at least one cambered surface is formed on the sidewall at the join of the sidewall and the polishing

surface so as to prevent the sidewall from being rubbed to generate small particles.

[Para 15] The present invention further provides another fabricating method of a polishing pad having a polishing surface, a back surface, and a sidewall connected with the polishing surface and the back surface. The method includes formation of at least one cambered surface on the sidewall of the polishing pad so as to prevent the sidewall from being rubbed to generate small particles.

[Para 16] According to the preferred embodiments of this invention, the above-mentioned stress buffer patterns can be formed, for example, in the polishing surface, the back surface, or both. The stress buffer pattern can be formed in the central region or the edge region of the polishing pad, for example, via a mechanical process, a chemical process, or a molding process. In addition, the stress buffer pattern can be a plurality of trenches or at least one opening. Moreover, the depth of the trenches or the opening is, for example, less than half of the thickness of the polishing pad.

[Para 17] According to the preferred embodiments of this invention, the above-mentioned cambered surface is formed on the sidewall of the polishing pad, for example, via a mechanical process, a chemical process, or a molding process.

[Para 18] According to the preferred embodiments of this invention, at least one cambered surface can be formed on the sidewall formed on a side surface of the trenches (or the openings) near the polishing surface. Similarly, the cambered surface is formed, for example, via a mechanical process, a chemical process, or a molding process.

[Para 19] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[Para 20] FIG. 1 is a top view showing a conventional polishing pad.

[Para 21] FIG. 2 is a top view showing a polishing pad according to one preferred embodiment of the present invention.

[Para 22] FIGs. 3A to 3K are sectional views showing a polishing pad according to preferred embodiments of the present invention.

[Para 23] FIG. 4 is a top view showing a polishing pad according to another preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[Para 24] Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer the same or like parts.

[Para 25] FIG. 2 is a top view showing a polishing pad according to one preferred embodiment of the present invention, while Fig. 3A is a cross-sectional view along the line I-I' in FIG. 2A according to one preferred embodiment of the present invention. Referring to FIG. 2 and FIG. 3A, the polishing pad 200 has a polishing surface 202 and a back surface 204, and the polishing pad 200 is divided into the polishing region 206 and the central region 210 neighboring to the polishing region 206. In this preferred embodiment, the polishing pad 200 is made of, for example, polymer, such as polyurethane, epoxy resin, melamine, or other thermosetting resin.

[Para 26] In the polishing region 206 of the polishing pad 200, there is a plurality of first trenches 208 to make polishing slurry evenly distributed on the polishing pad 200 during the polishing process. In addition, the central region 210 of the polishing pad 200 is, for instance, a circular region that is concentric with the surface of the polishing pad 200 and has a radius of 40 mm. In the present invention, the stress buffer pattern 212a is designed within the central region 210 of the polishing pad 200 to buffer compressing stress generated towards the central region 210 due to swing motion of the wafer during the polishing process, so that the surface of the central region 210 is prevented from being protruded under the compressing stress.

Wherein, the compressing stress is asserted in the direction, for example, as shown by the arrow 214.

[Para 27] In this preferred embodiment, the stress buffer pattern 212a may be, for example, an opening. The depth of the opening is, for example, greater than the depth of the first trenches 208 but less than half of the thickness d of the polishing pad 200. The stress buffer pattern 212a can be formed via a mechanical process, such as by using a cutter to cut the stress buffer pattern 212a, or via a chemical process, such as etching to form the stress buffer pattern 212a in the central region 210. Of course, the stress buffer pattern 212a can be also formed via a molding process.

[Para 28] In another preferred embodiment of the present invention, referring to FIG. 2 and FIG. 3B, the stress buffer pattern 212a can also be formed in the central region 210 of the back surface 204 of the polishing pad 200. The depth of the stress buffer pattern 212a is, for example, greater than the depth of the first trenches 208 but less than half of the thickness d of the polishing pad 200. The methods to form the stress buffer pattern 212a are the same as that described above, and thus no details are further given here for simplicity.

[Para 29] In yet another preferred embodiment of the present invention, referring to FIG. 2 and FIG. 3C, the stress buffer pattern 212a can be formed simultaneously on both the polishing surface 202 and the back surface 204 of the polishing pad 200. The depth of the stress buffer patterns 212a on the polishing surface 202 and on the back surface 204 is, for example, respectively greater than the depth of the first trenches 208, but additively less than half of the thickness d of the polishing pad 200.

[Para 30] In this embodiment, the stress buffer pattern on the polishing pad is illustrated as a single pattern of opening, which is set forth for the purpose of explanation but by no means to limit the shape of the stress buffer pattern. The stress buffer pattern on the polishing pad in this invention can be a pattern of other shapes formed in the central region of the polishing pad permissibly through any process. The stress buffer pattern can be, for example, a pattern of opening consisting of at least a circular opening or a polygonal opening.

[Para 31] In the above embodiment, the stress buffer pattern of the polishing pad is a pattern of opening. In yet another embodiment of this invention, however, the stress buffer pattern can also be a pattern consisting of a plurality of trenches.

[Para 32] Referring to FIG. 2 and FIG. 3D, the stress buffer pattern 212b may be, for example, a plurality of second trenches. The depth of the second trenches is, for example, greater than the depth of the first trenches 208 but less than half of the thickness d of the polishing pad 200. The stress buffer pattern 212b is designed within the central region 210 of the polishing pad 200 to buffer compressing stress generated towards the central region 210 due to swing motion of the wafer during the polishing process, so that the surface of the central region 210 is prevented from being protruded under the compressing stress. The methods to form the stress buffer pattern 212b are the same as that to form the stress buffer pattern 212a.

[Para 33] In yet another preferred embodiment of the present invention, referring to FIG. 2 and FIG. 3E, the stress buffer pattern 212b can also be formed in the central region 210 of the back surface 204 of the polishing pad 200. The depth of the stress buffer pattern 212b is, for example, greater than the depth of the first trenches 208 but less than half of the thickness d of the polishing pad 200.

[Para 34] In yet another preferred embodiment of the present invention, referring to FIG. 2 and FIG. 3F, the stress buffer pattern 212b can be formed simultaneously on both the polishing surface 202 and the back surface 204 of the polishing pad 200. The depth of the stress buffer patterns 212b on the polishing surface 202 and on the back surface 204 is, for example, respectively greater than the depth of the first trenches 208, but additively less than half of the thickness d of the polishing pad 200.

[Para 35] In addition, referring to FIG. 3G and FIG. 3H, a pattern of opening 202a and a pattern of trenches 202b can be designed in the central region 210 of the polishing surface 202 and the back surface 204, respectively. The total depth of the pattern 212a plus the pattern 212b is, for example, less than half of the thickness of the polishing pad 200.

[Para 36] In the above embodiment, the trenches of the stress buffer pattern can be in a distribution of concentric circle, spiral, whirlpool, grid, radial strips, or perforation. There is no limitation on such distribution in this invention.

[Para 37] In all of the embodiments of this invention, the depth of the stress buffer pattern on the polishing pad is, for example, greater than the depth of the trenches in the polishing region, and the additive depth of the stress buffer patterns on the polishing surface and on the back surface is less than half of the thickness of the polishing pad, so as to buffer compressing stress generated towards the central region of the polishing pad due to swing motion of the wafer during the polishing process, but, at the same time, not to cause breakage of the wafer when the central region becomes too thin. Accordingly, the present invention provides stress buffer patterns designed in the central region of the polishing pad to buffer the stress in the central region created during the polishing process to prevent the surface of the central region from being protruded and thus prevent the surface of the central region, once protruded, from rubbing against the wafer carrier, so that contamination of the surface of the wafers due to particles generated from the rubbing can be avoided.

[Para 38] In yet another preferred embodiment, in order to prevent particles from being generated when the sidewall 220, which connects the polishing surface 202 and the back surface 204 of the polishing pad 200, rubs against the retaining ring of the wafer carrier during a polishing process, a cambered surface 222 is formed at the join of the sidewall 220 and the polishing surface 202. The cambered surface 222 can be formed via a mechanical process, such as by using a cutter to cut on the sidewall 220 near the polishing surface 202 to form the cambered surface 222, or via a chemical process, such as etching to form the cambered surface 222 on the sidewall 200 at the join of the sidewall 220 and the polishing surface 202. Of course, the cambered surface 222 can be also formed via a molding process.

[Para 39] In accordance with yet another preferred embodiment, referring to FIG. 3J, a plurality of cambered surfaces 222 (two cambered surfaces are shown in FIG. 3J) can be formed at the join of the sidewall 220 and the

polishing surface 202 in order to prevent particles from being generated when the sidewall 220, which connects the polishing surface 202 and the back surface 204 of the polishing pad 200, rubs against the retaining ring of the wafer carrier during a polishing process. The methods to form such cambered surfaces are the same as that described above, and thus are not further described here for simplicity.

[Para 40] Referring to FIG. 3K, it is worthy of notice that after the stress buffer pattern 212a (i.e., the opening) is formed in the central region 210 of the polishing pad 200, the angle between the polishing surface 202 and the side surface 230 of the stress buffer pattern 212a is a straight right angle, and thus the edge portion of the right angle may similarly rub against the retaining ring of the wafer carrier to generate particles. Thus, at least one cambered surface 232 is formed on the side surface 230 of the stress buffer pattern 212a near the polishing surface 202. The methods for forming the cambered surface 232 are identical to that for forming the cambered surface 222, and thus are not further described for simplicity. As described above, a cambered surface is designed on the side surface 230 of the stress buffer pattern 212a of opening near the polishing surface 202. On the other hand, the cambered surface can also be designed on the side surface 230 of the stress buffer pattern 212b of trenches near the polishing surface 202. Moreover, the number of the cambered surfaces can be more than one.

[Para 41] As described in the foregoing embodiments, the cambered surface 222 are all shown in coexistence with the stress buffer pattern 212a or 212b. However, if the problem is focused on particles generated from the sidewall 220 of the polishing pad 200 during a polishing process, the cambered surface 222 could be designed without the presence of any stress buffer pattern. In other words, the stress buffer pattern or the cambered surface can be selectively designed on the polishing pad, or the stress buffer pattern and the cambered surface can be jointly designed on the polishing pad, so as to prevent the protruded central region of the polishing surface or the sidewall from rubbing against the wafer carrier, and prevent the wafers from being contaminated during the polishing process.

[Para 42] The above embodiments are described for a circular polishing pad. The present invention may also be applied to other polishing pads such as a linear polishing pad. As shown in Fig. 4, the polishing pad 300 is a linear polishing pad having a polishing region 306 and an edge region 310 neighboring to the polishing region 306, wherein the edge region 310 is beside the polishing region 306. In particular, at least one stress buffer pattern is formed in the edge region 310. The stress buffer pattern may be formed in the edge region 310 of the polishing surface, the back surface or both the polishing surface and the back surface as the above mentioned. In another embodiment, a cambered surface is further formed on the sidewall of the polishing pad 300 of Fig. 4, wherein the cambered surface is adjacent to the polishing surface as shown in fig. 3I and 3J. In another embodiment, a cambered surface is further formed on a side surface of the stress buffer pattern in the edge region 310 of the polishing pad 300 of Fig. 4, wherein the cambered surface is adjacent to the polishing surface as shown in Fig. 3K.

[Para 43] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention covers modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.